The Internet Journal of Nutrition and Wellness
Volume 8 Number 2

Correlates between Micronutrient Intake of Pregnant Women and Birth Weight of Infants from Central India

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Citation

D Kolte, R Sharma, S Vali. *Correlates between Micronutrient Intake of Pregnant Women and Birth Weight of Infants from Central India*. The Internet Journal of Nutrition and Wellness. 2008 Volume 8 Number 2.

Abstract

This study investigated the micronutrient status of 50 pregnant women attending Government Medical College and Hospital (GMH) and Private Maternity Clinics (PMC) from Central India and correlated its effect to the pregnancy outcome. Socioeconomic data, pregnancy related information, 24 hour dietary recall and information regarding the frequency of consumption of iron, folic acid, carotene and vitamin B_{12} rich foods was collected. Results indicated a low positive correlation between the mean dietary iron ($r = 0.012$, $r = 0.158$, $p<.05$) of the subjects and folic acid intake ($r = 0.175$, $r = 0.022$ $p<.05$) of the subjects and respective mean birth weights of infants among both GMH and PMC groups. Carotene had a low positive correlation ($r = 0.021$ $p<.05$,) with birth weight among the GMH subjects but low negative correlation ($r = - 0.227$, $p<.05$) amongst the PMC group. Vitamin B_{12} intake and mean birth weight in the PMC group subjects showed a low positive correlation ($r = 0.364$, $p<.05$) while a low positive correlation ($r = 0.021$ $p<.05$,) was observed in the GMH group. Multivariate analysis reflected an interrelationship between the socioeconomic status, pregnancy associated and dietary factors. The study concluded that a positive relation exists between the micronutrient intake of pregnant women and the birth weight of the infant.

INTRODUCTION

Micronutrients are essential for growth, and maternal micronutrient deficiency, frequently multiple in developing countries, may be an important cause of IUGR[1]. Micronutrient deficiency, whether clinical or sub-clinical, may affect growth, cognition, and reproductive performance. In pregnant women, moderate to severe deficiencies of iron, zinc and folic acid has been shown to increase risk of low birth weight, pregnancy complications and birth defects [2]. Pregnant women with anemia are at a higher risk for perinatal mortality and morbidity. There is evidence that supplementation with iron during pregnancy improves the birth weight of the infant [3]. Studies suggest that deficiency of folic acid influences the occurrence of low birth weight and preterm delivery [4]. Folic acid is an essential vitamin for the growth of healthy, new body cells. In general, folate is necessary for healthy blood and is very important to women in reducing their risk of having a baby with a serious birth defect [5].The low maternal vitamin B12 status is associated with intrauterine growth retardation in infants. There is also a relationship between neonatal serum B12 and birth weight. [6]

Despite several supplementation programmes being carried out by the government for the under privilege class of women the problem still exists with the same gravity and little respite. This calls for an immediate need for rigorous scientific research to assess the maternal nutritional status especially the micronutrient status and its correlation with pregnancy outcomes. The present investigation was therefore taken up to assess the relationship between micronutrient intake (iron, folic acid, vitamin A, and vitamin B12) to birth weight of infant in pregnant women coming for antenatal checkup at Government Medical College and Hospital (GMH) and those consulting gynecologists at Private Maternity Clinics (PMC). It was postulated that a difference in the income level may reflect on the micronutrient intake and consequently influence the birth outcome.

MATERIALS AND METHODS

Fifty pregnant women were selected by purposive sampling method, 25 each from GMH and PMC from Nagpur city (Maharashtra, India). The data was collected by oral questionnaire cum interview method. Pregnancy associated information of the subjects such as their weight before conception, the gain in weight during each trimester and Hb status, were gathered from their respective medical reports while the post delivery information was collected from the hospital records. Food habits, dietary pattern followed, foods consumed and avoided during pregnancies were noted down. The frequency of consumption of rich sources of iron, folic acid, vitamin A, and vitamin B12, recorded as daily, once a week, twice a week, sometimes, or never, was also recorded. The mean micronutrient intakes of the subjects were calculated and compared with their respective Recommended Dietary Allowances, as suggested by ICMR. Percent deficit was calculated for each micronutrient. The interrelationships between all parameters were calculated by Multi Variate Analysis/SPSS package.

RESULTS AND DISCUSSION

DEMOGRAPHIC DETAILS OF THE SUBJECTS:

The mean age of pregnant mothers was found to be 24 ± 2.33 and 27.9 ± 4.14 years from GMH and PMC respectively. The mean number of family members was found to be 4.2 ± 2.245 in the former subjects while it was 4 ± 3.51 in the latter. The average number of children born to pregnant women of both categories was found to be almost similar (01 ± 0.56 and 01 ± 0.36 respectively).

The subjects studied, differed in their educational qualification. Those attending GMH had an educational level ranging between primary to graduation. Pregnant women from PMC were graduates and postgraduates. It was observed that the income of the subjects varied largely. The mean annual income of the women of GMH was found to be Rs 28,207.2 ± 15,613.59 and that of the group taken from PMC was Rs 3, 41,840 ± 1,54,698 The mean annual expenditure on foods of the subjects of GMH was found to be Rs 14,589.12 ± 6,960.98 and that of the subjects taken from PMC was Rs 71,429 ± 29,783.21. Both the groups studied, from GMH as well as PMC showed a higher trend towards a joint family (60%, 68% respectively). Joint families tend to prove beneficial for the pregnant women as here; a woman receives proper attention by the family members, undergoes less stress, and is required to do a lesser amount of household work. Nuclear families pose a greater responsibility on the mothers. A greater percentage (88%) were found amongst the pregnant women of GMH were homemakers as compared to a mere 12% of working mothers. Amongst the pregnant women of PMC, the percentage of working women was 56% while homemakers constituted 44% of the total subjects.

FOOD HABITS AND DIETARY PATTERN OF SUBJECTS

The percentage of non-vegetarians was higher (44%) in pregnant women of GMH as compared to the PMC (24%). Maximum subjects from both the groups were vegetarians (52%), while the percentage of eggetarians was higher (24%) amongst the PMC in comparison with 4% of eggetarians amongst the GMH subjects. Some subjects were consuming egg and non-vegetarian foods, especially during pregnancy. Among the other foods that were added in their diets by the subjects of GMH during pregnancy were fruits and milk while the other group reported inclusion of coconut water, green leafy vegetables, sprouts, dates, soymilk and other nutritional supplements. On an average, maximum subjects avoided spicy and oily foods, papaya, all types of junk foods and salty foods like pickle. Some subjects from the PMC were also found to have stopped consuming sweets during pregnancy, as prescribed by the doctor, owing to their tendency of high blood glucose levels

WEIGHT GAIN DURING PREGNANCY

Table 1 shows the mean weight gain in pregnancy, and mean hemoglobin percent of pregnant women.

Figure 1

TABLE 1. Mean Weight Gain (Kg) and Hemoglobin (gm/dl) During Pregnancy

Sr.No	Characteristics	GMH (N=25)	PMC (N=25)
1	Pre pregnancy Weight	45 ± 7.00	50.88 ± 6.67
2.	Weight Gain in Ist Trimester	2.125 ± 1.53	2.52 ± 2.84
3.	Weight Gain in IInd Trimester	3 ± 1.95	4.96 ± 2.19
4.	Weight Gain in IIIrd Trimester	3.76 ± 2.26	3.64 ± 1.50
5.	Hemoglobin	9.78 ± 0.79	11.20 ± 0.84

On an average, the subjects of GMH showed a gradual increase in their weight gain during each trimester (2.125 kg, 3 kg, 3.76 kg respectively) while those in the PMC group showed an increase in average weight gain in the second trimester (4.96 kg), followed by a decrease in the mean weight gain in the third trimester (3.64 kg). The pre-conception weight of the subjects from both the groups was observed to be quite similar. The mean hemoglobin values of both the groups of subjects showed variation by about 2g/dl from each other, with the mean hemoglobin being 9.784g/dl in case of the GMH subjects and 11.207g/dl in case of the PMC group.

FREQUENCY OF CONSUMPTION OF RICH SOURCES OF MICRONUTRIENTS

The frequency of consumption of rich sources of micronutrients, calculated as daily, once a week, twice a week, sometimes or never, is represented in Table 2:

Figure 2

Table 2 Percent Distribution Of Pregnant Women According To Frequency Of Consumption Of Micronutrients Sources.

SN	Micronutrient Sources	GMH (N=25)					PMC (N=25)				
		Daily	Twice a week	Once a week	Some times	Never	Daily	Twice a week	Once a week	Some times	Never
1	Iron	-	4	20	40	36	24	20	20	32	04
2	Folic Acid	-	12	28	56	04	32	28	32	04	04
3	Carotene	8	28	16	36	12	60	16	12	12	00
4	Vitamin B_{12}	-	16	16	28	40	4	12	04	40	40

The Table 2 shows that none of the GMH subjects include rich sources of iron, folic acid, and vitamin B12 daily in their diets however, carotene rich foods like green leafy vegetables were being consumed by the subjects. Amongst the PMC group, a better consumption of these nutrients was observed, i.e, 60% for carotene, 32% for folic acid, 24% for iron, and only 4% for vitamin B12. A considerably larger percentage of subjects of both the groups (40%, 32%) were observed to consume iron rich sources only sometimes. 56% of the GMH group while only 4% of the PMC group subjects consumed folic acid sources only once or twice in a month. 40% of the PMC group subjects consumed vitamin B12 sources once in a while. Carotene sources were consumed more frequently among the PMC subjects, compared to the GMH group, in which as much as 36% were found to consume these foods only sometimes.

MEAN MICRONUTRIENT INTAKE OF THE SUBJECTS:

Micronutrients are essential for growth and micronutrient deficiency, whether clinical or sub-clinical, may affect growth, cognition, and reproductive performance. However, the negative effects of diets low in energy on pregnancy outcome are well documented; less clear are the effects of diets that are low in one or more essential micronutrients [2]. An attempt was made in the study to establish an association between maternal nutrition, with special reference to iron, folic acid, vitamin A and vitamin B12 and the resultant birth weight of the newborn. The mean intake of micronutrients among the subject group is given in Table 3.

Figure 3

TABLE 3 Mean Intakes Of Micronutrients Among The Subjects

S N	Micronutrients	GMH (N=25)		PMC (N=25)	
		Mean ±S D Intake	Per cent Deficit	Mean ±S D Intake	Per cent Deficit
1	Iron	9.80 ± 3.60 mg	74	16.14 ± 4.7008 mg	57.63
2	Folic Acid	128.72 ± 76.45μg	67.8	186 ± 68.50μg	53.5
3	Carotene	1642.13 ± 2500.87μg	31.2	2188.6 ± 1743.15μg	8.8
4	Vitamin B_{12}	0.22 ± 0.42μg	77.9	0.31 ± 0.21μg	68.9

Data from Table 3 shows an extremely deficient mean intake of dietary iron amongst the subjects of government as well as PMC groups (9.80 mg, 16.14 mg respectively). The diet of the population was also found to be lacking in folic acid, which is evident from their mean intake (128.72 μg, 186 μg respectively). A comparatively better intake was seen for carotene amongst the PMC group (2188.658 μg), but the women of GMH showed a deficient diet in carotene also (1642.139 μg) as compared to the recommended allowance of 2400 μg of carotene. The subjects being largely vegetarian, their diets were deficient in vitamin B12 (0.221 μg, 0.310 μg respectively).

The percent mean deficit of dietary iron amongst the subjects of both the groups was observed to be very high (74%, 57.63%) in relation to the recommended allowance of 38 mg/day. Folic acid (RDA- 400 μg), too, showed a very high percent deficit amongst the population (67.8%, 53.5%). Though some subjects consumed an excess carotene diet, maximum showed a deficit of 31.2% and 8.8%. Vitamin B12, being present only in non-vegetarian foods and milk, caused a deficit as much as 77.9% and 68.9% amongst the pregnant women of GMH and PMC respectively.

MICRONUTRIENTS AND BIRTH WEIGHT:

The mother's diet has a direct influence on the weight of the baby at birth. The average birth weight of the infants born to women eating inadequate and nutritionally poor diets is significantly lower than the average birth weight of babies, born to those consuming a nourishing diet[7]. Table 4 illustrates this association in detail with special reference to iron, folic acid, carotene, and vitamin B12 as under:

Figure 4

TABLE 4 Correlation Between Micronutrient Intake And Birth Weight of Infants

SN	Micronutrients	GMH Group		PMC Group	
		Mean Birth Weight (kg)	Coefficient of correlation	Mean Birth Weight (kg)	Coefficient of correlation
1	Iron	1.97	0.102	2.73	0.158
2	Folic Acid		0.175		0.022
3	Carotene		0.021		-0.227
4	Vitamin B12		0.021		0.364

P > 0.05

IRON:

Iron is essential for the formation of hemoglobin. Most studies report a strong association between iron intake and hemoglobin concentration [8,9,10]. For women, in their reproductive years the need for iron is often greater than the intake, due to factors such as iron loss with the onset of menstruation, and the increased requirements associated with pregnancy and lactation.

Data from Table 4 reflects a low positive correlation between the mean dietary iron intake of the subjects and mean birth weight among GMH as well PMC group subjects (r = 0.102, r = 0.158, P > 0.05 respectively). The 'inadequate iron intake causes inadequate iron status and hemoglobin production, which in turn leads to iron deficiency anemia', which has been found to influence the birth weight of the infant, in several studies[11]. The diet of the subjects was found to be deficient in iron; also their consumption of phytate being on a higher side (350.07 mg, 500.72 mg). Similarly, the enhancing effect of vitamin C and carotene on the absorption of non-heme iron has been observed repeatedly [12]. The intake of vitamin C was found to be very low (58.98 mg, 116.58 mg respectively) amongst the subjects from GMH as well as PMC groups.

However, some of the subjects were found to consume iron and folic acid supplements in the form of tablets, which is why, their hemoglobin percent correlated in a better way with the birth weights while dietary iron shows a low positive and insignificant correlation with the same. Observations from various iron studies have emphasized the beneficial role of iron supplementation in pregnancy. Supplemental iron has positive effects on various parameters such as improving hematological parameters, birth weight of the infant, fetal growth, etc[13]. Also, the Indian diet is mainly and largely cereal and pulse based, in which the iron content would look adequate for an adult. But the availability of iron from such diets is very poor. This reduced absorption is due to the inhibitory factors present in such foods like the phytates and tannins [14].

FOLIC ACID:

Folate functions as a coenzyme in reactions in the metabolism of nucleic and amino acids; therefore, in periods of enhanced anabolic activity, such as the one that occurs during pregnancy and lactation, folate requirements are increased. Less than optimal folate status has been associated with many negative reproductive outcomes such as an increased risk of neural tube defects, anemia in pregnancy, and low infant birth weight [15].

A low positive and insignificant correlation (r = 0.175, r = 0.022 , P > 0.05) was observed between the folic acid intake of the subjects and the birth weight. However, better results were reported by several researchers. A two fold greater risk of infant low birth weight in women with a low mean daily folate intake of 240 mg/day, which accounted for both dietary and supplementary forms of folate, at 28 weeks gestation have been reported[16]. A small but significant positive association between maternal folate intake at 18 and 30 weeks gestation and infant birth weight and a significant association between low serum folate levels at 30 weeks gestation has also been reported [17]. A positive association exists between infant birth weight and dietary intake of folate-rich foods in rural Indian women[18]. The maternal folate status is an important determinant of infant birth weight, folic acid is necessary for DNA & RNA synthesis[19].

CAROTENE:

. Vitamin A is essential for growth and differentiation of a number of cells and tissues. Notably during pregnancy, and throughout the breastfeeding period, vitamin A has an important role in the healthy development of the fetus and the newborn, with lung development and maturation being particularly importan[20].

Carotene is the most abundant provitamin A in food. It showed a low positive correlation (r = 0.021) with birth weight amongst the GMH population while it showed a negative correlation (r = -0.227, P > 0.05) amongst the PMC group. However these correlations were insignificant. Though some studies have a reported a positive association between vitamin A and birth weight, the role of carotene alone in determining the infant's weight at birth has not received much attention. However, some studies report no association of provitamin A, in the form of beta carotene, with birth defects. The present study reports that there is a low but positive relation between carotene and birth weight in the GMH groups. The negative correlation in the PMC class may be attributed to the low percent deficit amongst the population and normal mean birth weight.

The pregnancy outcome was not found to be independent of the maternal carotene intake in the GMH group while it was independent in case of PMC group subjects.

VITAMIN B12:

Vitamin B12, like folic acid, is essential for nucleic acid synthesis. It is a necessary compound for the proper metabolism of macronutrients, production of healthy red blood cells and a healthy growth and development. Vitamin B12 is also important for folate activity and calcium absorption. However, a limited supply of vitamin B12 during pregnancy may have very important consequences for fetal growth also. Low serum levels of maternal vitamin B12 have been associated with risk of neural tube defect-affected pregnancy [21].

The maternal vitamin B12 status was shown to be significantly associated with RBC folate status both in mother and neonate, but not with birth weight. The study also postulated that vitamin B12 status was not directly associated with birth weight; however, it proves to be an important component in maternal nutrition during pregnancy[19]. The results of the present study showed a low but positive correlation between maternal dietary vitamin B12 intake and infant birth weight. The correlation coefficient was higher in case of PMC group (r = 0.364, P > 0.05), owing to the higher milk intake amongst the subjects while the GMH population showed a negligible but positive (r = 0.021, P > 0.05) association between the two.

STATISTICAL INTERPRETATION USING MULTI-VARIATE ANALYSIS:

The data has been subjected to multivariate analysis to establish the correlation between different parameters under study within each group. The results are presented in Table 5 and 6 for GMH and PMC group subjects respectively.

Figure 5

TABLE 5 Multivariate Analysis of Variables In GMH Group Subjects

	Age	AI	AEF	PPW	GWI	GWII	GWIII	Hb	FeI	CI	FI	VBI	BW
Age	1	-0.03	- 0.08	- 0.1	-0.02	-0.17	-0.378	-0.14	-0.533**	-0.042	-0.03	0.028	-0.145
Annual Income (AI)		1	0.87**	-0.29	0.001	0.297	0.35	-0.162	0.006	0.016	0.147	-0.11	0.09
Annual Expenditure Foods (AEF)			1	-0.40	-0.01	0.273	0.298	-0.061	0.171	0.059	0.304	0.032	0.142
Pre Pregnancy Weight (PPW)				1	0.270	-0.28	0.123	0.258	0.006	-0.185	- 0.32	0.007	0.101
Weight Gain I (WGI)					1	-0.18	-0.257	-0.13	0.245	0.031	0.193	0.015	0.051
Weight Gain II (WGII)						1	0.441*	-0.194	0.0858	-0.031	0.077	-0.20	0.253
Weight Gain III (WGIII)							1	0.232	0.02	-0.095	-0.17	0.171	0.096
Hemoglobin (Hb)								1	0.054	0.0406	-0.05	0.415*	0.587**
Iron Intake (FeI)									1	0.422	0.5	0.2	0.102
Carotene Intake (CI)										1	0.735**	-0.09	0.021
Folic Acid Intake (FI)											1	0.142	0.175
Vitamin B12 Intake (VBI)												1	0.021
Birth Weight (BW)													1

* P < 0.05 ** P < 0.01

Age of the subjects showed a negligible negative correlation with the annual income (r = -0.03), expenditure on foods (r = -0.08), preconception weight (r = -0.1), as well as gain in weight during each trimester of pregnancy (r = - 0.02, - 0.17, - 0.378 respectively), hemoglobin concentration (r = -0.14), folic acid intake (r = -0.03), carotene intake (r = -0.042) and birth weight (r = -0.145) whereas a significant and negative association with iron intake (r = -0.533, P < 0.01) and a negligible positive correlation (r = 0.028) with dietary vitamin B12 intake.

Annual income of the subjects showed a low negative correlation with maternal prepregnancy weight (r = -0.29), hemoglobin concentration (r = -0.162) and vitamin B12 intake (r = -0.11); a high positive and significant correlation with the annual expenditure on food (r = 0.87) and a low positive correlation with weight gains during pregnancy (r = 0.001, r = 0.297, r = 0.35 respectively), iron intake (r = 0.006), folic acid intake (r = 0.147), carotene intake (r = 0.016) and birth weight (r = 0.09).

Annual expenditure of the subjects on food showed a low positive correlation with the weight gained in second (r = 0.273) and third trimester (r = 0.298), maternal iron intake (r = 0.171), folic acid intake (r = 0.304), carotene intake (r = 0.059), vitamin B12 intake (r = 0.032) and the birth weight of the infant (r = 0.142) while a low negative correlation with the prepregnancy weight of the mother (r = -0.40) and a negligible but negative correlation with weight gain in the first trimester (r = -0.01) and hemoglobin concentration (r = -0.061).

Preconception weight of the mother showed a low positive correlation with maternal weight gain in first (r = 0.270) and third (r = 0.123) trimesters, hemoglobin concentration (r = 0.258), iron (r = 0.006) and vitamin B12 intake (r = 0.007) and weight of the infant at birth (r = 0.101) whereas a low negative correlation with the weight gained in second trimester (r = -0.28) by the mother, and her folic acid (r = -0.32) and carotene intake (r = -0.185).

Weight gain in the first trimester had a low negative correlation with the weight gained in second (r = -0.18) and third (r = -0.257) trimesters as well as hemoglobin level of the mother (r = -0.13) while a low positive correlation with iron (r = 0.245), folic acid (r = 0.193), carotene (r = 0.031) and vitamin B12 (r = 0.015) intakes of the mother and birth weight of the newborn (r = 0.051) as well.

Second trimester weight gain showed a nearly high positive and significant correlation with weight gained in the third trimester (r = 0.441, P<0.05) and a low positive correlation with iron (r = 0.085) and folic acid (r = 0.077) intake and birth weight of the infant (r = 0.253) whereas as a low negative correlation with hemoglobin concentration (r = -0.194), carotene (r = -0.031) and vitamin B12 (r = -0.20) intake.

Weight gain in third trimester showed a low negative correlation with carotene (r = -0.095) and folic acid (r = -0.17) intake of the mothers and a low positive correlation with hemoglobin % (r = 0.232), iron (r = 0.02) and vitamin B12 (r = 0.171) intake and birth weight of the baby (r = 0.096).

Maternal hemoglobin concentration had a significant positive correlation with their vitamin B12 intake (r = 0.415, P<0.05) and birth weight (r = 0.587, P<0.01), low positive correlation with iron (r = 0.054) and carotene (r = 0.0406) intake while a low negative correlation with the folic acid intake (r = -0.05).

Iron intake of the mother reflected a positive and significant correlation with carotene (r = 0.422, P<0.05) and folic acid (r = 0.5) intake and a low positive correlation with vitamin B12 intake (r = 0.2) and birth weight (r = 0.102).

Carotene intake had a highly significant and positive correlation with folic acid intake (r = 0.735, P<0.01) while a low positive correlation with birth weight (r = 0.021) and a negative correlation with vitamin B12 intake (r = -0.09) of the mother.

Folic acid intake had low positive correlation with vitamin B12 intake (r = 0.142) and the birth weight (r = 0.175).

Vitamin B12 intake of the mothers showed a low positive correlation with the birth weight of the infant (r = 0.021).

Figure 6

TABLE 6 Multivariate Analysis of Variables In PMC Group Subjects

	Age	AI	AEF	PPW	GWI	GWII	GWIII	Hb	FeI	CI	FI	VBI	BW
Age	1	0.2	0.175	0.06	- 0.2	-0.07	- 0.11	0.073	- 0.2	0.134	0.095	0.276	-0.116
Annual Income (AI)		1	0.17	0.117	0.149	0.254	0.078	0.117	-0.12	0.117	-0.063	0.296	0.049
Annual Expenditure Foods (AEF)			1	0.169	-0.13	0.412*	0.122	-0.05	-0.16	-0.17	-0.288	-0.199	0.02
Pre Pregnancy Weight (PPW)				1	-0.18	0.028	-0.02	0.073	0.151	-0.05	0.036	-0.214	0.242
Weight Gain I (WGI)					1	0.406*	0.081	-0.23	-0.03	0.332	0.066	0.092	0.311
Weight Gain II (WGII)						1	0.153	0.039	0.123	-0.07	0.150	- 0.0273	0.189
Weight Gain III (WGIII)							1	-0.22	-0.25	-0.014	-0.275	0.179	0.323
Hemoglobin (Hb)								1	0.168	-0.310	0.354	-0.025	0.060
Iron Intake (FeI)									1	- 0.113	0.497*	- 0.2	0.158
Carotene Intake (CI)										1	0.11	0.199	-0.227
Folic Acid Intake (FI)											1	-0.03	0.022
Vitamin B12 Intake (VBI)												1	0.364
Birth Weight (BW)													1

* P < 0.05

Age showed a low positive correlation with annual income (r = 0.2), annual expenditure on food (r = 0.175), prepregnancy weight (r = 0.06), hemoglobin concentration (r = 0.073), carotene (r = 0.134), folic acid (r = 0.095) and vitamin B12 intake (r = 0.276) of the mother while a low negative correlation with the weights gains in each trimester (r = -0.2, r = -0.07, r = -0.11 respectively), iron intake (r = -0.2) and birth weight of the infant (r = -0.116).

Annual income had a low positive correlation with the expenditure on foods (r = 0.17), the prepregnancy weight of the mother (r = 0.117), weight gains during each trimester (r = 0.149, r = 0.254, r = 0.078 respectively), hemoglobin percent (0.117), carotene intake (r = 0.117), vitamin B12 intake (r = 0.296), and the birth weight (r = 0.049) whereas a low negative correlation with iron (r = -0.12) and folic acid (r = -0.063) intake of the mothers.

Annual expenditure on food had a significant and positive correlation with the weight gained in the second trimester (r = 0.412, * P < 0.05), a low positive correlation with prepregnancy weight (r = 0.169), third trimester weight gain (r = 0.122), and birth weight of the infant (r = 0.02) and a low negative correlation with first trimester weight gain (r = -0.13), hemoglobin percent (r = -0.05), iron (r = -0.16), folic acid (r = -0.288), carotene (r = -0.17) and vitamin B12 (r = -0.199) intake of the subjects.

Prepregnancy weight of the mother showed low negative correlation with weight gained in first (r = -0.18) and third (r = -0.02) trimester, carotene (r = -0.05) and vitamin B12 (r = -0.214) intake whereas low positive correlation with weight gain in second trimester (r = 0.028), hemoglobin per cent (r = 0.073), iron (r = 0.151) and folic acid (r = 0.036) intake and birth weight of the infant (r = 0.242).

Weight gain in first trimester had a significant positive correlation with that gained in second trimester (r = 0.406 * P < 0.05) and birth weight (r = 0.3111), whereas low positive correlation with third trimester weight gain (r = 0.081), carotene (r = 0.332), folic acid (r = 0.066) and vitamin B12 (r = 0.092) intake of the mother and a high negative correlation with maternal hemoglobin per cent (r = -0.23) and iron intake (r = -0.03).

Second trimester weight gain showed a low positive correlation with third trimester weight gain (r = 0.153), hemoglobin (r = 0.039), iron (r = 0.123) and folic acid (r = 0.150) intake and birth weight (r = 0.189) while a negligible negative correlation with carotene (r = -0.07) and vitamin B12 (r = -0.0273) intake of the mother.

Weight gained during the third trimester had a low negative correlation with maternal hemoglobin (r = -0.22), iron (r = -0.25), folic acid (r = -0.275) and carotene (r = -0.014) intake while a positive correlation with vitamin B12 intake (r = 0.179) and the birth weight (r = 0.323) of the infant.

Maternal hemoglobin was positively correlated to the iron (r = 0.168) and folic acid (r = 0.354) intake and birth weight (r = 0.060) of the infant and negatively correlated to carotene (r = -0.310) and vitamin B12 (r = -0.025) intake of the mother.

Iron intake of the mother was significantly correlated to her folic acid intake (r = 0.497* P < 0.05), had a low positive correlation with birth weight (r = 0.158) and a low negative correlation with carotene (r = -0.113) and vitamin B12 (r = -0.2) intake.

Carotene intake showed a low negative correlation with birth weight (r = -0.227) and a low positive correlation with folic acid (0.11) and vitamin B12 (r = 0.199) intake.

Folic acid intake had low positive correlation with birth weight (r = 0.022) of the newborn and low negative correlation with vitamin B12 intake (r = -0.03).

Maternal vitamin B12 intake was positively correlated to the birth weight of the infant (r = 0.364).

From the data presented in Table 5 and 6 , it can be inferred that socioeconomic status, living conditions, income, education, cultural influences, and awareness among the people have a direct influence on the health of the community. Between the subject groups that were dealt with in this study, i.e, the pregnant women from low and high income groups, a vast difference in the availability of basic amenities was observed which was found to be directly related to their pregnancy outcome, especially birth weight, a major factor for this being, the direct relationship of annual income to annual expenditure on foods as calculated in this study. However, of all the parameters, the most significant correlation was found between the anemic status of the mother as indicated by her hemoglobin concentration and the resultant birth weight, among both low as well as high income groups; indicating that irrespective of the socioeconomic status, maternal hemoglobin status during pregnancy proves to be a detrimental factor for birth weight.

CONCLUSION

The results obtained from the study indicate that micronutrient deficiency during pregnancy has a positive correlation with the birth weight of the infant. It can also be inferred from the study that it is not only the effect of food intake, but the interlinks of various social and cultural factors that modify the food intake and have an adverse influence on health and nutritional status of the pregnant woman, which in turn, influences the pregnancy outcome and birth weight of the infant.

ACKNOWLEDGEMENT

The authors are thankful to the Dean, Government Medical College and Hospital, Nagpur , Dr Vibhavari Dani, Head of the Gynocology Department, Dr Mrs. Sadhana Deshmukh, Gynecologist at Renuka Maternity Clinic, Nagpur, Dr Mrs.

Mansi Shirgiriwar, Gynecologist at Muktai Maternity Clinic, Nagpur , for extending help during the study.

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